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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS.

DIETARY STUDIES

AT

PURDUE UNIVERSITY, LAFAYETTE, IND.,

IN

1895

BY

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WITH COMMENTS,

BY

W. O. ATWATER and CHAS. D. WOODS.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., June 15, 1896.

SIR: I have the honor to transmit herewith a report on dietary studies at Purdue University, Lafayette, Ind., in 1895, by Winthrop E. Stone, Ph. D., professor of chemistry at the university. These investigations constitute a part of the inquiries made with the funds appropriated by Congress "to enable the Secretary of Agriculture to investigate and report upon the nutritive value of the various articles and commodities used for human food." They were conducted under the immediate supervision of Prof. W. O. Atwater, special agent in charge of nutrition investigations, in accordance with instructions given by the Director of this Office. Mr. H. M. Smith, special agent of this Department, assisted in carrying on the investigations.

The dietary studies previously made in the United States have been confined to a small number of places. In carrying out the provisions of the act above cited, representative localities have been selected in different parts of the country, in order that definite information regarding the food supply and consumption of people living under different conditions might be obtained. Lafayette, Ind., is near the eastern edge of the prairie region of the middle West, and it is believed that the food habits of people living in this region would be very much alike. Purdue University possesses well-equipped laboratories, and offered some exceptional facilities for carrying on food investigations.

The dietary study with the teacher's family is particularly interesting, since it corresponds quite closely with the current dietary standards, and at the same time the cost is very moderate. It is a good example of what may be accomplished by judicious expenditure of money and careful selection of available food materials. Comments on these investigations made by Professors Atwater and Woods, and appended to Professor Stone's report herewith, indicate the value of the Indiana dietary studies as compared with similar investigations carried on elsewhere.

Professor Stone's report and the accompanying comments by the special agents of this Department are submitted, with the recommendation that they be published as Bulletin No. 32 of this Office.

Respectfully,

A. C. TRUE,
Director.

HON. J. STERLING MORTON,
Secretary of Agriculture.

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DIETARY STUDIES AT PURDUE UNIVERSITY.

Two dietary studies were made at Purdue University, one with the family of a teacher and the other with the family of a mechanic. They form part of a series, carried out in various localities, to learn the habits of food consumption of the people of the United States. The methods followed were those described at length in a previous publication.[1]

The observations were made with two principal ends in view: (1) To ascertain the net amount of food materials of various kinds consumed by the families during stated periods; and (2) by sampling and chemical analysis of these food materials, to ascertain their composition, and thus the total amount of nutrients consumed during the given time.

The general plan of the studies may be briefly outlined as follows: At the beginning of each dietary study a careful inventory by weight was taken of all the food and food materials in the house. During exactly fourteen days all food purchased was weighed and recorded in the same way, and all table and kitchen waste carefully collected, weighed, and desiccated for subsequent analysis. At the close of the period a second inventory of all materials on hand was taken. In this way the necessary data for ascertaining the net amounts of food consumed were secured. Samples of food materials on hand or purchased during the period were secured and, when necessary, desiccated in a drying oven at about 90° C. These were ground and mixed in the usual way for analysis, and in these prepared samples the moisture, ash, nitrogen, and fat were determined. The methods employed for the analysis of the specimens of food are the same as those used by Atwater and Woods,[2] and quoted at length in Bulletin No. 29 of this Office.

The results of the analyses are given in the three tables which follow. Table 1 shows the composition of the food materials as found in the market, including both edible portion and refuse; Table 2 the composition of the edible portion on the basis of the water content at the time in which the samples were taken, and Table 3 the composition of the water-free substance of the edible portion. In addition to the ordinary data of composition, Tables 1 and 2 present also the estimated fuel value or potential energy of the foods.

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

[2] Connecticut Storrs Station Report 1891, p. 41 et seq.

TABLE 1.—*Composition of food materials as purchased (including both edible portion and refuse).*

[Analyzed at Lafayette, Ind.]

Kind of food material.	Reference number.	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD.								
Beef:								
Porterhouse steak, native beef	58	*Per ct.* 14.5	*Per ct.* 53.9	*Per ct.* 19.8	*Per ct.* 10.8	*Per cent.*	*Per ct.* 1.0	*Calories.* 825
Do	79	11.2	50.6	16.6	20.7	....	.9	1,180
Average	....	12.9	52.2	18.2	15.7	....	1.0	1,000
Sirloin steak, native beef	80	17.2	52.1	15.3	14.6	....	.8	900
Do	81	19.5	55.0	8.5	16.6	....	.4	860
Average	....	18.3	53.6	11.9	15.6	....	.6	880
Ribs	171	28.7	40.5	12.1	18.1	....	.6	990
Round	248	....	66.2	21.6	11.1	....	1.1	870
Do	233	17.3	57.2	16.9	7.7	....	.9	640
Do	249	5.6	59.8	18.8	14.8	....	1.0	975
Average 2 analyses	....	11.5	58.5	17.8	11.2	....	1.0	805
Rump	259	17.3	57.6	17.8	6.3	....	1.0	595
Do	260	9.9	66.8	19.3	2.9	....	1.1	480
Average	....	13.6	62.2	18.6	4.6	....	1.0	540
Shoulder	305	8.8	65.1	19.0	6.1	....	1.0	610
Do	319	13.3	58.0	16.5	11.3	....	.9	785
Average	....	11.1	61.5	17.8	8.7	....	.9	700
Veal:								
Leg, round	1020	7.8	68.8	19.7	2.6	....	1.1	475
Do	1021	4.5	69.5	20.2	4.7	....	1.1	575
Do	1022	8.9	68.9	18.9	2.2	....	1.1	445
Do	1023	4.7	70.3	20.6	3.2	....	1.2	520
Do	1024	5.4	67.9	19.9	5.7	....	1.1	610
Do	1025	4.7	71.6	21.4	1.1	....	1.2	445
Do	1035	3.6	66.8	19.7	8.9	....	1.0	740
Average	....	5.6	69.1	20.1	4.1	....	1.1	545
Loin, with kidney	1053	9.1	66.7	12.8	10.7	....	.7	690
Pork:								
Round	2050	11.6	51.1	16.6	19.8	....	.9	1,145
Smoked ham	2068	4.8	28.3	14.5	51.9	....	.5	2,460
Lard, kettle-rendered	4035	....	....	....	100.0	....	....	4,220
Do	4036	....	....	....	100.0	....	....	4,220
Butter	22	....	8.0	.1	89.6	....	2.3	3,785
Do	47	....	8.0	.1	89.6	....	2.3	3,785
Cheese, American full milk	3541	....	31.6	37.0	25.3	1.4	4.7	1,785
Milk	23	....	88.0	3.3	3.9	4.1	.7	305
Do	44	....	89.5	3.4	2.8	3.6	.7	250
Average	....	....	88.8	3.3	3.3	3.9	.7	275
VEGETABLE FOOD.								
Corn meal, granular, home-grown	5028	....	13.2	9.7	4.0	71.8	1.3	1,685
Hominy	5038	....	11.4	9.5	.7	78.0	.4	1,655
Oats, rolled	5066	....	11.2	18.4	5.8	62.8	1.8	1,760
Wheat flour, graham	5109	....	10.8	15.5	2.8	69.1	1.8	1,690
Wheat flour, roller processs	5149	....	10.8	14.7	.6	73.4	.5	1,665
Wheat flour	5256	....	11.5	12.0	.9	75.2	.4	1,660
Wheat flour, pastry	5280	....	10.8	12.3	.6	75.9	.4	1,665
Bread, white, baker's	5427	....	40.2	8.7	.7	49.7	.7	1,115
Cake, baker's	5465	....	28.3	4.6	5.9	60.5	.7	1,460
Vanilla wafers	5504	....	5.8	6.8	15.7	71.2	.5	2,115
Beans, canned, with pork	6862	....	76.1	5.2	2.1	15.2	1.4	465
Sweet potatoes, canned	7073	....	42.0	2.6	.5	53.6	1.3	1,065

TABLE 2.—*Composition of fresh, edible portion of food materials.*

[Analyzed at Lafayette, Ind.]

Kinds of food material.	Reference number.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD.							
Beef:		*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	*Per ct.*	*Calories.*
Porterhouse steak, native beef	58	63.1	23.1	12.6	....	1.2	960
Do	79	57.0	18.7	23.3	....	1.0	1,330
Average	....	60.0	20.9	18.0	....	1.1	1,145
Sirloin steak, native beef	80	62.9	18.5	17.6	....	1.0	1,085
Do	81	68.3	10.6	20.6	....	.5	1,065
Average	....	65.6	14.6	19.1	....	.7	1,075
Ribs	171	56.8	17.0	25.4	....	.8	1,390
Round	233	69.2	20.4	9.3	....	1.1	770
Do	248	66.2	21.6	11.1	....	1.1	870
Do	249	63.3	19.9	15.7	....	1.1	1,035
Average	....	66.2	20.6	12.1	....	1.1	890
Rump	259	69.7	21.5	7.6	....	1.2	720
Do	260	74.2	21.4	3.2	....	1.2	535
Average	....	72.0	21.4	5.4	....	1.2	625
Shoulder	305	71.4	20.8	6.7	....	1.1	670
Do	319	66.9	19.0	13.1	....	1.0	905
Average	....	69.1	19.9	9.9	....	1.1	790
Veal:							
Leg, round	1020	74.6	21.4	2.8	....	1.2	515
Do	1021	72.8	21.1	5.0	....	1.1	605
Do	1022	75.6	20.8	2.4	....	1.2	490
Do	1023	73.8	21.6	3.4	....	1.2	545
Do	1024	71.8	21.0	6.0	....	1.2	645
Do	1025	75.1	22.5	1.1	....	1.3	465
Do	1035	69.3	20.4	9.2	....	1.1	765
Average	....	73.3	21.2	4.3	....	1.2	575
Loin, with kidney	1050	73.3	14.1	11.8	....	.8	760
Pork:							
Round	2050	57.7	18.8	22.4	....	1.1	1,295
Smoked ham	2068	29.7	15.2	54.5	....	.6	2,585
Lard, kettle-rendered	4035	....	....	100.0	....	....	4,220
Do	4036	....	....	100.0	....	....	4,220
Butter	22	8.0	.1	89.6	....	2.3	3,785
Do	47	8.0	.1	89.6	....	2.3	3,785
Cheese, American full milk	3541	31.6	37.0	25.3	1.4	4.7	1,785
Milk	23	88.0	3.3	3.9	4.1	.7	305
Do	44	89.5	3.4	2.8	3.6	.7	250
Average	....	88.8	3.3	3.3	3.9	.7	275
VEGETABLE FOOD.							
Corn meal, granular, home-grown	5028	13.2	9.7	4.0	71.8	1.3	1,685
Hominy, home-grown	5038	11.4	9.5	.7	78.0	.4	1,655
Oats, rolled	5066	11.2	18.4	5.8	62.8	1.8	1,760
Wheat flour, graham	5109	10.8	15.5	2.8	69.1	1.8	1,690
Wheat flour, roller process	5149	10.8	14.7	.6	73.4	.5	1,665
Wheat flour	5256	11.5	12.0	.9	75.2	.4	1,660
Wheat flour, pastry	5280	10.8	12.3	.6	75.9	.4	1,665
Bread, white, baker's	5427	40.2	8.7	.7	49.7	.7	1,115
Cake, baker's	5465	28.3	4.6	5.9	60.5	.7	1,460
Vanilla wafers	5504	5.8	6.8	15.7	71.2	.5	2,115
Beans, canned, with pork	6862	76.1	5.2	2.1	15.2	1.4	465
Sweet potato, canned	7073	42.0	2.6	.5	53.6	1.3	1,065

TABLE 3.—*Composition of water-free substance of edible portion of food materials.*

[*Analyzed at Lafayette, Ind.*]

Kind of food material.	Reference number.	Nitrogen.	Protein.	Fat.	Carbohydrates.	Ash.
ANIMAL FOOD.						
Beef.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Porterhouse steak, native beef	58	10.51	62.6	34.1	....	3.3
Do	79	7.25	43.5	54.2	....	2.3
Average	....	8.88	53.0	44.2	....	2.8
Sirloin steak, native beef	80	8.13	49.9	47.4	....	2.7
Do	81	5.35	33.4	65.0	....	1.6
Average	....	6.74	41.7	56.2	....	2.1
Ribs	171	6.49	39.4	58.8	....	1.8
Round	233	10.95	66.2	30.2	....	3.6
Do	248	10.59	63.9	32.8	....	3.3
Do	249	8.93	54.2	42.8	....	3.0
Average	....	10.16	61.4	35.3	....	3.3
Rump	259	11.46	71.0	25.0	....	4.0
Do	260	13.52	82.9	12.4	....	4.7
Average	....	12.49	76.9	18.7	....	4.4
Shoulder	305	11.84	72.7	23.4	....	3.9
Do	319	9.81	57.4	39.6	....	3.0
Average	....	10.82	65.1	31.5	....	3.4
Veal:						
Leg, round	1020	13.72	84.3	11.0	....	4.7
Do	1021	12.42	77.6	18.4	....	4.0
Do	1022	13.53	85.3	9.8	....	4.9
Do	1023	13.16	82.4	13.0	....	4.6
Do	1024	11.82	74.5	21.3	....	4.2
Do	1025	14.[illegible]	90.4	4.4	....	5.2
Do	1035	10.59	66.4	30.0	....	3.6
Average	....	12.74	80.1	15.4	....	4.5
Loin, with kidney	1053	8.80	52.8	44.2	....	3.0
Pork:						
Round	2050	7.55	44.4	53.0	....	2.6
Smoked ham	2068	2.73	21.6	77.5	....	.9
Lard, kettle-rendered	4035	....	100.0	....	....	....
Do	4036	....	100.0	....	....	....
Butter	22	....	.1	97.4	....	2.5
Do	47	....	.1	97.4	....	2.5
Cheese, American full milk	3541	....	54.1	37.0	2.0	6.9
Milk	23	....	27.5	32.5	34.2	5.8
Do	44	....	32.4	26.7	34.3	6.6
Average	....	....	30.0	29.6	34.2	6.2
VEGETABLE FOOD.						
Corn meal, home-grown, granular	5028	....	11.2	4.6	82.7	1.5
Hominy, home-grown	5038	....	10.7	.8	88.0	.5
Oats, rolled	5066	....	20.7	6.5	70.7	2.1
Wheat flour, graham	5109	....	17.4	3.1	77.5	2.0
Wheat flour, roller process	5149	....	16.5	.7	82.3	.5
Wheat flour	5256	....	13.6	1.0	84.9	.5
Wheat flour, pastry	5280	....	13.8	.7	85.1	.4
Bread, white, baker's	5427	....	14.5	1.2	83.1	1.2
Cakes, baker's	5465	....	6.4	8.2	84.4	1.0
Vanilla wafers	5504	....	7.2	16.7	75.6	.5
Beans, baked, canned, with pork	6862	....	21.8	8.8	63.6	5.8
Sweet potatoes, canned	7073	....	4.5	.9	92.4	2.2

THE DIETARY STUDIES.

The results of two dietary studies are given in the following pages. The tables under both are alike, and one description will answer.

The figures in the first three columns of the first table (Tables 4

and 7) of each dietary show the percentage composition of the foods used, based upon the condition of the food as it was purchased, including bone or other refuse. The fourth column shows the price paid for the amount of each food purchased, and the remaining columns give the total weight of each kind of food, together with the amounts of the different nutrients—protein, fat, and carbohydrates—contained therein.

In all cases where the amount of food was large or of unknown composition, such as native beef, pork, milk, butter, flour, corn meal, etc., samples were analyzed in connection with the dietary study. In all such cases the letter *a* is placed after the name of the food material. These analyses are given in Tables 1 to 3, above. Where the article was not analyzed, its percentage composition was taken from the table of average composition of American foods in Bulletin No. 31 of this Office.

The weights of the dried, table, and kitchen wastes[1] and their composition are given in the last line of the first table in each dietary (Tables 4 and 7).

The second table in each dietary (Tables 5 and 8) shows the relative proportion of the several classes of food materials in the dietary and the nutrients furnished by each class. It tells its story so plainly as to require little comment.

The last table in each dietary (Tables 6 and 9) gives the nutrients and *fuel values in food purchased, in table and kitchen wastes, and in the* portion actually eaten. The estimates of animal and vegetable nutrients in the waste are computed as described below. In estimating the fuel values of the nutritive ingredients, the protein and carbohydrates are assumed to contain 4.1 and the fats 9.3 calories of potential energy per gram.

It was not practicable in the collection of the wastes to distinguish between that which came from animal and that from vegetable food. It is, however, possible to estimate with more or less accuracy how much of the nutritive materials came from the animal and how much from the vegetable foods. As there were practically no carbohydrates in any of the animal foods except milk and cheese, and but little in these, there is no great error in assuming that all waste carbohydrates came from the vegetable foods. It will also be fairly accurate to assume that there are the same proportions of protein, fat, and carbohydrates in the vegetable waste as in the whole vegetable food purchased. In other words, the amount of vegetable protein and vegetable fat in the waste will bear nearly the same ratio to the total

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[1] The words "refuse" and "waste" are used somewhat indiscriminately. In general, refuse in animal food represents inedible material, although bone, tendon, etc., which are classed as refuse, may be utilized for soup. The refuse of vegetable foods, such as parings, seeds, etc., represent not only inedible material, but also more or less of edible material. The waste included the edible portion of the food, as pieces of meat, bread, etc., which might be saved, but is actually thrown away with the refuse.

amount of vegetable protein and fat in the food purchased that the carbohydrates of the waste does to the total carbodydrates of the vegetable food. Taking the percentages of the weights of the carbohydrates in the total waste as the measure of the protein and fats in the vegetable wastes, the actual weights of protein and fat in the latter are readily calculated. Subtracting these weights of vegetable protein and fat from the total weight of these ingredients in the waste, the remainder gives the amounts of animal protein and fats in the whole waste.

Tables 10 and 11 give a summary of the results of the two dietary studies.

DIETARY OF A TEACHER'S FAMILY IN INDIANA (No. 44).[1]

The study began March 8, 1895, and continued fourteen days.

The members of the family and number of meals taken were as follows:

	Meals.
Man between 50 and 60 years old	42
Man 25 years old	42
2 men 22 years old	84
Woman between 40 and 50 years old (42 meals × 0.8 meal of man) equivalent to	34
Woman 30 years old (42 meals × 0.8 meal of man) equivalent to	33
Total number of meals equivalent to	235

Equivalent to one man seventy-eight days.

Remarks.—One of the men was a professor of mathematics, another an instructor in chemistry, the other two, students. The younger woman also was a teacher. They were all healthy, active persons, with good appetites, and used no stimulants, narcotics, or medicines in any form.

TABLE 4.—*Food materials and table and kitchen wastes in dietary study No. 44.*

Kind of food material.	Percentage composition. Protein.	Percentage composition. Fat.	Percentage composition. Carbohydrates.	Total cost.	Weight used. Total food material.	Nutrients. Protein.	Nutrients. Fat.	Nutrients. Carbohydrates.
ANIMAL FOOD.								
Beef:	*Per ct.*	*Per ct.*	*Per cent.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
Porterhouse (*a*)	16.6	20.7		$0.20	905	150	187	
Round (*a*)	21.6	11.1		.15	680	147	75	
Do. (*a*)	19.0	6.1		.45	2,040	388	124	
Do. (*a*)	18.8	14.8		.16	735	139	109	
Sirloin (*a*)	15.3	14.6		.28	1,275	195	186	
Shoulder (*a*)	16.5	11.3		.36	1,955	323	221	
Do.	16.5	11.3		.42	2,270	374	257	
Smoked, dried	31.8	6.8	0.6	.25	905	288	62	5
Total				2.27	10,765	2,004	1,221	5
Veal:								
Round (*a*)	19.7	2.6			1,020	201	27	
Do. (*a*)	20.2	4.7			1,075	218	51	
Do. (*a*)	18.9	2.2			540	102	12	
Do. (*a*)	20.6	3.2			1,245	257	40	
Do. (*a*)	19.7	8.9			1,075	211	96	
Do. (*a*)	19.9	5.7			540	107	31	
Do. (*a*)	21.4	1.1			1,105	237	13	
Total				1.84	6,600	1,333	270	

a Specimen analyzed. See explanation, p. 11.

[1] The numbers of the dietary studies are laboratory numbers used in the investigations of which this study forms a part.

TABLE 4.—*Food materials and table and kitchen wastes in dietary study No. 44*—Cont'd.

Kind of food material.	Percentage composition.			Total cost.	Weight used.			
					Total food material.	Nutrients.		
	Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.
ANIMAL FOOD—continued.								
Pork:	*Per ct.*	*Per ct.*	*Per cent.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
Round (*a*)	16.6	19.8		$0.10	455	76	90	
Lard (*a*)		100.0		.60	2,495		2,495	
Total				.70	2,950	76	2,585	
Eggs	13.1	9.5		1.17	4,705	616	447	
Butter (*a*)	.1	89.6		1.06	1,785	2	1,599	
Milk (*a*)	3.3	3.9	4.1	2.57	55,055	1,817	2,147	2,257
Mince-meat	6.5	1.4	60.4	.16	370	24	5	224
Total animal food				9.77	82,230	5,872	8,274	2,486
VEGETABLE FOOD.								
Cereals, sugar, etc.:								
Corn meal (*a*)	9.6	4.0	71.8	.08	2,395	232	96	1,718
Hominy (*a*)	9.5	.7	78.0	.02	255	24	2	199
Flour, bread (*a*)	14.8	.6	73.4	.25	7,540	1,116	45	5,535
Flour, pastry (*a*)	12.3	.6	75.9	.30	6,945	854	42	5,272
Oatmeal	15.6	7.3	68.0	.02	240	37	18	163
Crackers, milk	9.3	13.1	69.2	.03	140	13	18	97
Sugar, granulated			100.0	.24	2,295			2,295
Sugar, "C"			95.0	.43	4,310			4,094
Sirup, maple			70.0	.25	895			627
Honey			75.1	.20	425			319
Total				1.82	25,440	2,276	221	20,319
Vegetables:								
Beans, dried (*a*)	22.5	1.4	61.0	.09	835	187	12	510
Cabbage	1.8	.3	4.9	.32	2,890	52	9	141
Corn, canned	2.8	1.3	19.3	.25	1,210	34	16	233
Lettuce	1.1	.3	2.7	.40	905	10	3	24
Parsnips	1.3	.5	12.9	.05	795	10	4	103
Potatoes (30.9 per cent refuse)	2.1	.1	18.0	.28	6,750	142	7	1,215
Radishes	1.0	.1	4.6	.05	310	3		14
Total				1.44	13,695	438	51	2,240
Fruits, nuts, etc.:								
Apples (34.4 per cent refuse)	.5	.5	16.6	.40	5,470	27	27	908
Bananas (28.6 per cent refuse)	1.2	.8	22.9	.30	1,420	17	11	325
Cranberries	.5	.7	10.1	.05	355	2	2	36
Oranges (25 per cent refuse)	.8	.6	9.7	.20	540	4	3	52
Peaches, dried	2.9		63.3	.28	865	25		547
Prunes, dried	2.0	.7	58.6	.10	440	9	3	258
Raisins	2.5	4.7	74.7	.01	45	1	2	34
Total				1.34	9,135	85	48	2,160
Total vegetable food				4.60	48,270	2,799	320	24,719
Total food				14.37	130,500	8,671	8,594	27,205
Table and kitchen waste (*a*)	20.8	33.6	42.1		1,800	374	605	758
Fat		100.0			10		10	
Total					1,810	374	615	758

a Specimen analyzed. See explanation, p. 11.

TABLE 5.—*Weights and percentages of food materials and nutritive ingredients used in dietary study No. 44.*

Kind of food material.	Weight in grams.				Weight in pounds.				Cost.
	Food material.	Nutrients.			Food material.	Nutrients.			
		Protein.	Fat.	Carbohydrates.		Protein.	Fat.	Carbohydrates.	
FOR FAMILY 14 DAYS.									
Beef, veal, and mutton	17,365	3,337	1,491	5	38.3	7.3	3.3	....	$4.11
Pork, lard, etc	2,950	76	2,585	....	6.5	.2	5.7	....	.70
Eggs	4,705	616	447	....	10.4	1.3	1.0	....	1.17
Butter	1,785	2	1,599	....	3.9	......	3.5	....	1.06
Milk	55,055	1,817	2,147	2,257	121.4	4.0	4.7	5.0	2.57
Mince-meat	370	24	5	224	.8	.1	......	.5	.16
Total animal food	82,230	5,872	8,274	2,486	181.3	12.9	18.2	5.5	9.77
Cereals, sugars, starches	25,440	2,276	221	20,319	56.0	5.0	.5	44.8	1.82
Vegetables	13,695	438	51	2,240	30.2	1.0	.1	4.9	1.44
Fruits	9,135	85	48	2,160	20.2	.2	.1	4.8	1.34
Total vegetable food	48,270	2,799	320	24,719	106.4	6.2	.7	54.5	4.60
Total food	130,500	8,671	8,594	27,205	287.7	19.1	18.9	60.0	14.37
PER MAN PER DAY.									
Beef, veal, and mutton	222	43	19	....	.49	.10	.04	....	......
Pork, lard, etc	38	1	33	....	.08	......	.07	....	......
Eggs	60	8	6	....	.13	.02	.01	....	......
Butter	23	....	20	....	.05	......	.05	....	......
Milk	706	23	28	29	1.56	.05	.06	.06	......
Mince-meat	5	....	....	3	.01	......	......	.01	......
Total animal food	1,054	75	106	32	2.32	.17	.23	.07	.12
Cereals, sugars, starches	326	29	3	260	.72	.07	.01	.57	......
Vegetables	176	6	1	29	.39	.01	......	.07	......
Fruits	117	1	....	28	.26	......	......	.06	......
Total vegetable food	619	36	4	317	1.37	.08	.01	.70	.06
Total food	*1,673*	*111*	*110*	*349*	*3.69*	*.25*	*.24*	*.77*	*.18*
PERCENTAGES OF TOTAL FOOD.									
	Per ct.	*Per ct.*	*Per ct.*	*Per cent.*					*Per ct.*
Beef, veal, and mutton	13.3	38.5	17.3	....	......	......	......	....	28.6
Pork, lard, etc	2.2	.9	30.1	....	......	......	......	....	4.9
Eggs	3.6	7.1	5.2	....	......	......	......	....	8.1
Butter	1.4	....	18.6	....	......	......	......	....	7.4
Milk	42.2	20.9	25.0	8.3	......	......	......	....	17.9
Mince-meat	.3	.3	.1	.8	......	......	......	....	1.1
Total animal food	63.0	67.7	96.3	9.1	......	......	......	....	68.0
Cereals, sugars, starches	19.5	26.2	2.6	74.7	......	......	......	....	12.7
Vegetables	10.5	5.1	.6	8.2	......	......	......	....	10.0
Fruits	7.0	1.0	.5	8.0	......	......	......	....	9.3
Total vegetable food	37.0	32.3	3.7	90.9	......	......	......	....	32.0
Total food	100.0	100.0	100.0	100.0	......	......	......	....	100.0

TABLE 6.—*Nutrients and potential energy in food purchased, rejected, and eaten in dietary study No. 44.*

Kind of food material.	Cost.	Nutrients.			Fuel value.
		Protein.	Fat.	Carbohydrates.	
Food purchased:		*Grams.*	*Grams.*	*Grams.*	*Calories.*
Animal	$9.77	5,872	8,274	2,486	111,220
Vegetable	4.60	2,799	320	24,719	115,800
Total	14.37	8,671	8,594	27,205	227,020
Waste:					
Animal	....	283	605	....	6,790
Vegetable	....	91	10	738	3,490
Total	....	374	615	738	10,280
Food actually eaten:					
Animal	....	5,589	7,669	2,486	104,430
Vegetable	....	2,708	310	23,981	112,310
Total	....	8,297	7,979	26,467	216,740
PER MAN PER DAY.					
Food purchased:					
Animal	.12	75	106	32	1,425
Vegetable	.06	36	4	317	1,485
Total	.18	111	110	349	2,910
Waste:					
Animal	....	4	8	....	90
Vegetable	....	1	....	9	40
Total	....	5	8	9	130
Food actually eaten:					
Animal	....	71	98	32	1,335
Vegetable	....	35	4	308	1,445
Total	....	106	102	340	2,780
PERCENTAGES OF TOTAL FOOD PURCHASED.					
Food purchased:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Animal	68.0	67.7	96.3	9.1	49.0
Vegetable	32.0	32.3	3.7	90.9	51.0
Total	100.0	100.0	100.0	100.0	100.0
Waste:					
Animal	....	3.3	7.0	....	3.0
Vegetable	....	1.0	....	2.7	1.5
Total	....	4.3	7.0	2.7	4.5
Food actually eaten:					
Animal	....	64.4	89.3	9.1	46.0
Vegetable	....	31.3	3.7	88.2	49.5
Total	....	95.7	93.0	97.3	95.5

DIETARY OF A TINNER'S FAMILY IN INDIANA (No. 49).

The study began April 22, 1895, and continued fourteen days.

The members of the family and number of meals taken were as follows:

	Meals.
Man about 55 years old	42
Man about 20 years old	28
Woman about 48 years old (42 meals × 0.8 meal of man) equivalent to	33
Visitors	2
Total number of meals taken equivalent to	105

Equivalent to one man thirty-five days.

Remarks.—The family consisted of three adult persons, in good health and with active occupation. They were not very "hearty eaters." The men smoked tobacco moderately, otherwise none of the family were addicted to stimulants or narcotics.

The men conducted a small business of their own and worked rather less hours than hired laborers.

TABLE 7.—*Food materials and table and kitchen wastes in dietary study No. 49.*

Kind of food material.	Percentage composition.			Total cost.	Weight used.			
					Total food material.	Nutrients.		
	Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.
ANIMAL FOOD.								
Beef:	*Per ct.*	*Per ct.*	*Per cent.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
Porterhouse (*a*)	19.8	10.8	....	$0.26	810	160	87	....
Sirloin (*a*)	8.5	16.6	....	.27	990	84	165	....
Rib roast (*a*)	12.2	18.1	....	.28	1,265	154	229	....
Round (*a*)	16.9	7.7	....	.19	680	115	52	....
Rump (*a*)	17.8	6.3	....	.15	680	121	43	....
Do	19.3	2.9	....	.13	565	110	16	....
Total	....	....	....	1.28	4,990	744	592	....
Veal: Loin (*a*)	12.8	10.8	....	.32	1,825	234	196	....
Pork:								
Ham (*a*)	14.5	51.9	....	.37	965	140	501	....
Lard (*a*)	....	100.0	....	.23	1,600	....	1,600	....
Total	....	....	....	.60	2,565	140	2,101	....
Eggs	13.1	9.5	....	.74	3,565	467	339	....
Butter (*a*)	.1	89.6	....	.70	1,505	2	1,348	....
Cheese (*a*)	37.0	25.3	1.4	.18	455	168	115	6
Milk (*a*)	3.4	2.8	3.6	.57	10,390	353	291	374
Buttermilk	3.0	.5	4.8	.06	2,440	73	12	117
Total animal food	....	....	....	4.45	27,735	2,181	4,994	497
VEGETABLE FOOD.								
Cereals, sugar, etc.:								
Flour, wheat (*a*)	12.0	.9	75.2	.08	2,835	340	26	2,132
Oats, rolled (*a*)	18.4	5.8	62.8	.03	240	44	14	151
Bread, wheat, baker's (*a*)	8.7	.7	49.7	.67	7,855	683	55	3,904
Cake, baker's (*a*)	4.6	5.9	60.5	.56	2,565	118	151	1,552
Wafers, vanilla (*a*)	6.8	15.7	71.2	.40	935	64	147	666
Sugar, granulated	....	....	100.0	.17	2,525	....	....	2,525
Sugar, "Coffee A" (*a*)	....	....	86.6	.24	1,530	....	....	1,326
Sirup	....	....	72.0	.03	600	....	....	432
Total	....	....	....	2.18	19,085	1,249	393	12,688
Vegetables:								
Asparagus	1.8	.2	3.3	.20	795	14	2	26
Beans, baked, canned (*a*)	5.2	2.1	15.2	.15	795	41	17	121
Lettuce	1.1	.3	2.7	.20	455	5	1	12
Onions	1.5	.4	8.9	.10	340	5	1	30
Potatoes	1.8	.1	15.3	.22	7,770	139	8	1,189
Radishes	1.0	.1	4.6	.05	455	5	....	21
Rhubarb	.4	.4	2.2	.10	850	3	3	19
Sweet potatoes, canned (*a*)	2.6	.5	53.6	.15	1,175	31	6	629
Total	....	....	....	1.17	12,635	243	38	2,047
Fruits, nuts, etc.:								
Bananas	.7	.5	13.7	.60	2,610	18	13	358
Blackberries, canned	.8	2.1	56.4	.15	1,330	11	28	750
Grapes, canned	.6	.7	13.0	.15	1,275	8	9	166
Oranges	.6	.4	7.1	.20	1,505	9	6	107
Strawberries	1.0	.7	6.8	.15	455	5	3	31
Total	....	....	....	1.25	7,175	51	59	1,412
Total vegetable food	....	....	....	4.60	38,895	1,543	490	16,147
Total food	....	....	....	9.05	66,630	3,724	5,484	16,644
Table and kitchen waste (*a*)	15.2	20.7	63.3	....	3,715	565	769	2,352
Fat	....	100.0	....	....	50	....	50	....
Total	....	....	....	....	3,765	565	819	2,352

a Specimen analyzed. See explanation, p. 11.

TABLE 8.—*Weights and percentages of food materials and nutritive ingredients used in dietary study No. 49.*

Kind of food material.	Weight in grams.				Weight in pounds.				Cost.
	Food material.	Nutrients.			Food material.	Nutrients.			
		Protein.	Fat.	Carbohydrates.		Protein.	Fat.	Carbohydrates.	
FOR FAMILY 14 DAYS.									
Beef, veal, and mutton	6,815	978	788	....	15.0	2.1	1.7	....	$1.60
Pork, lard, etc	2,565	140	2,101	....	5.7	.3	4.6	....	.60
Eggs	3,565	467	339	....	7.8	1.0	.8	....	.74
Butter	1,505	2	1,348	....	3.3	......	3.0	....	.70
Cheese	455	168	115	6	1.0	.4	.3	....	.18
Milk	10,390	353	291	374	22.9	.8	.6	.8	.57
Buttermilk	2,440	73	12	117	5.4	.2	......	.3	.06
Total animal food	27,735	2,181	4,994	497	61.1	4.8	11.0	1.1	4.45
Cereals, sugars, starches	19,085	1,249	393	12,688	42.1	2.8	.9	28.0	2.18
Vegetables	12,635	243	38	2,047	27.9	.5	.1	4.5	1.17
Fruits	7,175	51	59	1,412	15.8	.1	.1	3.1	1.25
Total vegetable food	38,895	1,543	490	16,147	85.8	3.4	1.1	35.6	4.60
Total food	66,630	3,724	5,484	16,644	146.9	8.2	12.1	36.7	9.05
PER MAN PER DAY.									
Beef, veal, and mutton	195	28	23	....	.43	.06	.05	....	......
Pork, lard, etc	73	4	60	....	.16	.01	.13	....	......
Eggs	102	13	10	....	.22	.03	.02	....	......
Butter	43	....	38	....	.10	......	.09	....	......
Cheese	13	5	3	....	.03	.01	.01	....	......
Milk	297	10	9	11	.65	.02	.02	.02	......
Buttermilk	70	2	....	3	.15	......	......	.01	......
Total animal food	793	62	143	14	1.74	.13	.32	.03	.13
Cereals, sugars, starches	545	36	11	363	1.20	.08	.02	.80	......
Vegetables	361	7	1	58	.80	.02	......	.13	......
Fruits	205	1	2	40	.45	......	.01	.09	......
Total vegetable food	1,111	44	14	461	2.45	.10	.03	1.02	.13
Total food	1,904	106	157	475	4.19	.23	.35	1.05	.26
PERCENTAGES OF TOTAL FOOD.	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*					*Per ct.*
Beef, veal, and mutton	10.2	26.3	14.4	....	....	......	......	....	17.7
Pork, lard, etc	3.8	3.8	38.3	....	....	......	......	....	6.6
Eggs	5.4	12.5	6.2	....	....	......	......	....	8.2
Butter	2.3	....	24.6	....	....	......	......	....	7.7
Cheese	.7	4.5	2.1	....	....	......	......	....	2.0
Milk	15.6	9.5	5.3	2.3	....	......	......	....	6.3
Buttermilk	3.6	2.0	.2	.7	....	......	......	....	.7
Total animal food	41.6	58.6	91.1	3.0	....	......	......	....	49.2
Cereals, sugars, starches	28.6	33.5	7.1	76.2	....	......	......	....	24.1
Vegetables	19.0	6.5	.7	12.3	....	......	......	....	12.9
Fruits	10.8	1.4	1.1	8.5	....	......	......	....	13.8
Total vegetable food	58.4	41.4	8.9	97.0	....	......	......	....	50.8
Total food	100.0	100.0	100.0	100.0	....	......	......	....	100.0

TABLE 9.—Nutrients and potential energy in food purchased, rejected, and eaten in dietary study No. 49.

Kind of food material.	Cost.	Nutrients.			Fuel value.
		Protein.	Fat.	Carbohydrates.	
Food purchased:		*Grams.*	*Grams.*	*Grams.*	*Calories.*
Animal	$4.45	2,181	4,994	497	57,420
Vegetable	4.60	1,543	490	16,147	77,090
Total	9.05	3,724	5,484	16,644	134,510
Waste:					
Animal		459	785		9,180
Vegetable		106	34	2,352	10,400
Total		565	819	2,352	19,580
Food actually eaten:					
Animal		1,722	4,209	497	48,240
Vegetable		1,437	456	13,795	66,690
Total		3,159	4,665	14,292	114,930
PER MAN PER DAY.					
Food purchased:					
Animal	.13	62	143	14	1,640
Vegetable	.13	44	14	461	2,200
Total	.26	106	157	475	3,840
Waste:					
Animal		13	22		260
Vegetable		3	1	67	295
Total		16	23	67	555
Food actually eaten:					
Animal		49	121	14	1,345
Vegetable		41	13	394	1,940
Total		90	134	408	3,285
PERCENTAGES OF TOTAL FOOD PURCHASED.					
Food purchased:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Animal	49.2	58.6	91.1	3.0	42.7
Vegetable	50.8	41.4	8.9	97.0	57.3
Total	100.0	100.0	100.0	100.0	100.0
Waste:					
Animal		12.3	14.3		6.8
Vegetable		2.9	.6	14.1	7.7
Total		15.2	14.9	14.1	14.5
Food actually eaten:					
Animal		46.3	76.8	3.0	35.9
Vegetable		38.5	8.3	82.9	49.6
Total		84.8	85.1	85.9	85.5

TABLE 10.—*Summary of weights and percentages of food materials and nutritive ingredients used in dietary studies Nos. 44 and 49.*

Kind of food material.	Weight.					Percentage of total food.				
	Food material.	Nutrients.			Cost.	Food material.	Nutrients.			Cost.
		Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.	
PER MAN PER DAY.										
Teacher's family.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Cents.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	*Per ct.*
Beef, veal, and mutton..	222	43	19	....	5.2	13.3	38.5	17.3	....	28.6
Pork, lard, etc..........	38	1	33	....	.9	2.2	.9	30.1	....	4.9
Eggs..................	60	8	6	....	1.4	3.6	7.1	5.2	....	8.1
Butter..................	23	....	20	....	1.3	1.4	......	18.6	....	7.4
Milk....................	706	23	28	29	3.2	42.2	20.9	25.0	8.3	17.9
Mince-meat..............	5	(1)	(1)	3	......	.3	.3	.1	.8	1.1
Total animal food.	1,054	75	106	32	12.0	63.0	67.7	96.3	9.1	68.0
Cereals, sugars, starches	326	29	3	260	2.4	19.5	26.2	2.6	74.7	12.7
Vegetables..............	176	6	1	29	1.9	10.5	5.1	.6	8.2	10.0
Fruits..................	117	1	(1)	28	1.7	7.0	1.0	.5	8.0	9.3
Total vegetable food..........	619	36	4	317	6.0	37.0	32.3	3.7	90.9	32.0
Total food........	1,673	111	110	349	18.0	100.0	100.0	100.0	100.0	100.0
Tinner's family.										
Beef, veal, and mutton..	195	28	23	....	4.5	10.2	26.3	14.4	....	17.7
Pork, lard, etc..........	73	4	60	....	2.4	3.8	3.8	38.3	....	6.6
Eggs..................	102	13	10	....	1.7	5.4	12.5	6.2	....	8.2
Butter..................	43	....	38	....	2.1	2.3	......	24.6	....	7.7
Cheese..................	13	5	3	....	.5	.7	4.5	2.1	....	2.0
Milk....................	297	10	9	11	1.6	15.6	9.5	5.3	2.3	6.3
Buttermilk..............	70	2	(1)	3	.2	3.6	2.0	.2	.7	.7
Total animal food.	793	62	143	14	13.0	41.6	58.6	91.1	3.0	49.2
Cereals, sugars, starches	545	36	11	363	6.2	28.6	33.5	7.1	76.2	24.1
Vegetables..............	361	7	1	58	3.3	19.0	6.5	.7	12.3	12.9
Fruits..................	205	1	2	40	3.5	10.8	1.4	1.1	8.5	13.8
Total vegetable food..........	1,111	44	14	461	13.0	58.4	41.4	8.9	97.0	50.8
Total food........	1,904	106	157	475	26.0	100.0	100.0	100.0	100.0	100.0

1 Less than 1 gram.

TABLE 11.—*Nutrients and potential energy in food purchased, rejected, and eaten per man per day in dietary studies Nos. 44 and 49.*

Kind of food material.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
TEACHER'S FAMILY.					
Food purchased:		*Grams.*	*Grams.*	*Grams.*	*Calories.*
Animal	$0.12	75	106	32	1,425
Vegetable	.06	36	4	317	1,485
Total	.18	111	110	349	2,910
Waste:					
Animal		4	8		90
Vegetable		1		9	40
Total		5	8	9	130
Food actually eaten:					
Animal		71	98	32	1,335
Vegetable		35	4	308	1,445
Total		106	102	340	2,780
TINNER'S FAMILY.					
Food purchased:					
Animal	.13	62	143	14	1,640
Vegetable	.13	44	14	461	2,200
Total	.26	106	157	475	3,840
Waste:					
Animal		13	22		260
Vegetable		3	1	67	295
Total		16	23	67	555
Food actually eaten:					
Animal		49	121	14	1,345
Vegetable		41	13	394	1,940
Total		90	134	408	3,285

Some discussion of the data obtained in these dietary studies will doubtless render them more easily intelligible and direct attention to certain features which might otherwise escape notice.

COMPOSITION OF THE FOOD MATERIALS.

The analyses of food materials here recorded relate almost without exception to local products, which may be taken as fairly representative of the food supplies available in a considerable section of the "Middle West." Such analyses have therefore a particular interest as giving accurate information regarding the composition and nutritive value of the food products of a certain locality. They also furnish a means of comparison with similar products in other localities or countries; and, finally, they contribute to the general fund of information being accumulated for the purpose of a general study of American food stuffs. It would, however, be unjustifiable to draw general conclusions from the limited number of analyses herewith reported. As compared with the small number of other recorded analyses of beef, it would seem that the samples used in these dietaries contained less fat in the edible portion, the effect of which may be traced in the somewhat lower fuel values per pound. This may be regarded as a desira-

ble characteristic, since it is probable that, from the standpoint of food value, much American beef is too fat. In their most valued constituent, protein, these meats are in nowise inferior, but in most cases show a relatively high percentage of this substance.

The dairy products, with the exception of butter, contain on the average a comparatively low amount of solids and fats, while the vegetable foods show relatively a high content of protein and fats.

REFUSE IN MEATS.

There is a general lack of accurate knowledge as to the percentage of refuse in meats (bones, skin, etc). For this reason the data given in Table 1 will be of some interest. In some instances this refuse amounts to nearly 30 per cent of the weight of meat purchased and rarely falls below 10 per cent. Of the remaining "edible portion," usually from 50 to 70 per cent is found to be water. Considering the prices of meats as compared with other foods, it is easily seen that the actual cost of the nutrients in this form is very high. With 12 per cent of refuse and 60 per cent of water in the edible portion of a given specimen of meat, the actual nutritive portion constitutes only about one-third the purchased weight, or, in other words, the actual cost of the nutrients in such meat is three times the apparent cost. Of course, in the absence of bone, this objection is largely removed.

RELATIVE CHARACTER AND COST OF THE DIETARIES.

The summaries of the two dietaries given in Tables 10 and 11 present several interesting features. From these the exact proportions of the different kinds of animal and vegetable foods which went to make up the daily rations can be learned, the proportional sums spent for these, the total amount of food consumed per individual, the total cost per individual, and, finally, what is particularly interesting from the standpoint of economy, the proportion of the food which was respectively wasted and consumed in the two families.

It will be of interest first to compare the relative proportion of animal and vegetable food purchased per man per day. In the teacher's family this was 1,054 grams (2.32 pounds) of animal and 619 grams (1.36 pounds) of vegetable food; in the tinner's family this proportion was virtually reversed, the amounts being 793 grams (1.75 pounds) and 1,111 grams (2.45 pounds). These figures express very clearly the dietary habits of the two families.

The relative sums spent for animal and vegetable foods in the teacher's family were 12 and 6 cents respectively, and in the tinner's family 13 and 13 cents per man per day—that is, the tinner's family spent 1 cent more for animal food than the teacher's family and more than twice as much for vegetable foods.

Reference to the items of the two dietaries shows that the teacher's family purchased more substantial and more nourishing food than the

tinner's family, although in less quantity. The former ate home-made bread and cakes, the latter bought baker's bread and occasionally cake. The teacher's family consumed more than twice as much milk per man per day as the tinner's family, while the latter purchased rather more of fruits and vegetables. The total food purchased by the teacher's family per man per day was 1,673 grams (3.69 pounds), at a cost of 18 cents; by the tinner's family 1,904 grams (4.20 pounds), at a cost of 26 cents. This food contained, respectively, of the nutrient substances 570 grams (1.26 pounds) and 738 grams (1.62 pounds), of which 548 grams (1.21 pounds) and 632 grams (1.39 pounds) were consumed in the respective families. The relative cost of the two dietaries was as 1 to 1.44 and *the relative consumption of nutrients was as 1 to 1.15.* These results are exceedingly instructive with regard to economy of living and well worth careful study. They show very plainly that the more costly dietary is not necessarily the more attractive or nutritious. It could not be said that the tinner's dietary, which cost 26 cents per day, was in any way preferable to that of the teacher's family which cost 18 cents per day. On the contrary, the latter was the more rational and substantial.

The difference in cost was due largely to the character and to some extent to the greater amount of food purchased. The tinner purchased 1.29 times as much edible nutrients as the teacher; but only consumed 1.15 times as much. The discrepancy between cost, amount purchased, and consumption was due to two causes, which are without doubt the two principal errors in general household economy in America. The first was the purchase of nutrients in their more expensive forms. The second was the undue proportion of waste of materials which were in themselves edible. The final table, which summarizes the amounts of animal and vegetable foods respectively purchased, wasted, and eaten brings out this latter fact with great distinctness. In the teacher's family 96.1 per cent of all food purchased was actually eaten and only 3.9 per cent wasted. In the tinner's family, only 85.6 of the purchased food was eaten and 14.4 per cent wasted. Without detracting from the attractiveness or value of the daily food in any way, there was opportunity in the latter case for economy in two ways, viz, in purchasing the food and in avoiding wastes.

The dietary of the teacher's family constitutes an exceptionally good example of intelligent and economical management, securing at the same time excellent living. The tinner's dietary was in no way an exception, but is probably quite typical of the manner of living of the great majority of wage earners of the better class.

COMMENTS ON THE DIETARY STUDIES AT PURDUE UNIVERSITY.

By W. O. ATWATER and CHAS. D. WOODS.

In the preceding pages Professor Stone has reported the results of two interesting dietary studies, one of the family of a professional man (teacher in a college), the other of a mechanic's family. Both families were selected as being more or less typical of the classes which they represent. It will be interesting to compare the results of these studies with others obtained elsewhere and with the so-called "dietary standards."

STANDARDS FOR DIETARIES.

The most satisfactory standards for dietaries must be based upon the quantities of nutrients best suited to the nutrition of a particular individual or class. This, which may be called the physiological standard, can be found only in the observed facts of normal metabolism, and would take into consideration only what is best adapted to the actual demand for nutriment. The most economical standard would take into account not only the actual demands of the body for nourishment, but the kinds of food available and their pecuniary cost. Unfortunately, the data now at hand are too few and too incomplete to make accurate estimates of the physiological demands of people of different classes, and on this account the so-called dietary standards are for the most part based upon the observed facts of food consumption. The standards which have been suggested by one of the writers,[1] and which are given below, are based upon the assumptions that the body requires for its nourishment enough of protein to replace all of the nitrogenous substances consumed in the body and enough of energy to supply the demand for heat and work. They differ somewhat from the standards proposed by Voit and others in Europe twenty or more years ago, partly because more recent research in the science of nutrition has brought new information, but chiefly because the results of studies of American dietaries have been taken into account in making the estimates.

[1] American and European Dietaries and Dietary Standards, by W. O. Atwater, Connecticut Storrs Station Report, 1891. See also U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 206 et seq.

Standards for daily dietaries.

	Protein.	Fuel value.	Nutritive ratio.
	Grams.	*Calories.*	
Man without muscular work	100	2,700	1:5.6
Man with light muscular work	112	3,000	1:5.5
Man with moderate muscular work	125	3,500	1:5.8

In the discussion which follows, these standards are to be understood to represent simply tentative estimates of the protein and energy required. Later research may be expected to furnish data for the revision of these figures, and they are in no sense to be considered as exact or final.

DIETARIES OF MECHANICS' FAMILIES.

In the table which follows are given the condensed results of several dietary studies of mechanics' families in Connecticut,[1] one in Tennessee,[2] and one in Indiana, reported in previous pages.

Dietaries of mechanics' families in Connecticut, Indiana, and Tennessee.

	Per man per day.				Nutritive ratio.
	Protein.	Fat.	Carbohydrates.	Fuel value.	
MECHANICS' FAMILIES IN CONNECTICUT.	*Grams.*	*Grams.*	*Grams.*	*Calories.*	
Dietary with minimum protein, food purchased	100	159	427	3,640	1:7.9
Dietary with maximum protein, food purchased	126	188	426	4,010	1:6.8
Dietary with minimum energy, food purchased	111	144	377	3,335	1:6.3
Dietary with maximum energy, food purchased	126	188	426	4,010	1:6.8
Average 7 dietaries:					
Food purchased—					
Animal	69	150	22	1,770	....
Vegetable	45	8	414	1,950	....
Total	114	158	436	3,720	1:7.0
Waste, total	7	12	13	195	....
Food eaten, total	107	146	423	3,525	1:7.0
MECHANIC'S FAMILY IN INDIANA.					
Food purchased:					
Animal	62	143	14	1,640	....
Vegetable	44	14	461	2,200	....
Total	106	157	475	3,840	1:8.9
Waste, total	16	23	67	555	....
Food eaten, total	90	134	408	3,285	1:8.9
MECHANIC'S FAMILY IN TENNESSEE.					
Food purchased:					
Animal	63	214	15	2,310	....
Vegetable	56	10	440	2,125	....
Total	119	224	455	4,435	1:8.1
Waste, total	9	14	43	345	....
Food eaten, total	110	210	412	4,090	1:8.1
MECHANICS' FAMILIES.					
Average of all (9) of above:					
Food purchased—					
Animal	68	157	20	1,820	....
Vegetable	46	8	423	2,000	....
Total	114	165	443	3,820	1:7.2
Waste, total	9	13	23	250	....
Food eaten	105	152	420	3,570	1:7.3

[1] Connecticut Storrs Station Reports, 1891–1895.

[2] U. S. Dept. Agr., Office of Experiment Stations Bul. 29.

The figures of the above tables are more concisely compared in the following:

Protein, fuel value, and nutritive ratio of dietaries of mechanics' families in Connecticut, Tennessee, and Indiana.

	Number of families.	Protein.	Fuel value.	Nutritive ratio.
Food eaten:		*Grams.*	*Calories.*	
Connecticut	7	107	3,525	1:7.0
Indiana	1	90	3,285	1:8.9
Tennessee	1	110	4,090	1:8.1
All	9	105	3,570	1:7.3
Standard for man at light muscular work		112	3,000	1:5.5
Standard for man at moderate muscular work		125	3,500	1:5.8

It will be observed that all of the above dietaries have nutritive ratios much larger than the standards. Viewed from this point, the dietaries are deficient in protein. With the exception of the Tennessee family, the fuel values agree quite closely with the standards. The large nutritive ratio of the Indiana dietary is due chiefly to the use of lard and butter in relatively large amounts; in Tennessee the family used large quantities of lard, fat pork, and bacon. To the fatness of meats, the abundance and comparative cheapness of sugar, starches, and pork, and the common use of "sweets" of all kinds the large nutritive ratio of American dietaries is chiefly to be attributed.

DIETARIES OF FAMILIES OF PROFESSIONAL MEN.

In the table which follows are given the condensed results of several dietaries of professional men in Connecticut, Pennsylvania, Indiana, and Illinois. The studies in Connecticut were reported by the writers;[1] the study in Pennsylvania was made by Prof. Belle Bevier, of the Pennsylvania Woman's College, at Pittsburg, in cooperation with this Department; the studies in Illinois were made in Evanston and Chicago in cooperation with the Hull House for this Department by Miss C. L. Hunt, and the one in Indiana is that reported in previous pages. The results of the studies in Pennsylvania and Illinois have not yet been published.

[1] Connecticut Storrs Station Reports, 1891-1895.

Dietaries of families of professional men (chiefly college professors) in Connecticut, Pennsylvania, Indiana, and Illinois.

	Per man per day.				Nutritive ratio.
	Protein.	Fat.	Carbohydrates.	Fuel value.	
PROFESSIONAL MEN'S FAMILIES IN CONNECTICUT.	*Grams.*	*Grams.*	*Grams.*	*Calories.*	
Dietary with minimum protein, food purchased	91	126	483	3, 525	1:8.4
Dietary with maximum protein, food purchased	120	147	440	3, 660	1:6.4
Dietary with minimum energy, food purchased	118	103	430	3, 205	1:5.6
Dietary with maximum energy, food purchased	120	147	440	3, 660	1:6.4
Average 7 dietary studies of 4 families:					
Food purchased—					
Animal	66	114	23	1, 425	....
Vegetable	43	15	415	2, 025	....
Total	109	129	438	3, 450	1:6.7
Waste, total	4	6	3	85	....
Food eaten, total	105	123	435	3, 365	1:6.8
PROFESSIONAL MAN'S FAMILY IN PENNSYLVANIA.					
Food purchased:					
Animal	54	168	16	1, 850	....
Vegetable	67	8	507	2, 425	....
Total	121	176	523	4, 275	1:7.6
Waste, total	7	11	17	200	....
Food eaten, total	114	165	506	4, 075	1:7.7
PROFESSIONAL MAN'S FAMILY IN INDIANA.					
Food purchased:					
Animal	75	106	32	1, 425	....
Vegetable	36	4	317	1, 485	....
Total	111	110	349	2, 910	1:5.4
Waste, total	5	8	9	130	....
Food eaten, total	106	102	340	2, 780	1:5.4
PROFESSIONAL MEN'S FAMILIES IN ILLINOIS.					
Dietary with minimum protein, food purchased	92	103	300	2, 565	1:5.8
Dietary with maximum protein, food purchased	123	138	359	3, 260	1:5.5
Dietary with minimum energy, food purchased	92	103	300	2, 565	1:5.8
Dietary with maximum energy, food purchased	97	120	627	4, 085	1:9.3
Average 3 dietaries:					
Food purchased—					
Animal	66	112	25	1, 410	....
Vegetable	38	8	404	1, 895	....
Total	104	120	429	3, 305	1:6.8
No estimation of waste made.					
PROFESSIONAL MEN'S FAMILIES.					
Average of all (9) of above:					
Food purchased—					
Animal	65	118	24	1, 460	....
Vegetable	44	11	411	1, 970	....
Total	109	129	435	3, 430	1:6.4
Waste, total[1]	5	7	7	115	....
Food eaten, total	104	122	428	3, 315	1:6.8

[1] Average 6 dietaries.

The figures of the above table are more concisely stated in the following:

Protein, fuel value, and nutritive ratio of dietaries of families of professional men in Connecticut, Pennsylvania, Indiana, and Illinois.

	Number of families.	Per man per day.		Nutritive ratio.
		Protein.	Fuel value.	
Food eaten:		*Grams.*	*Calories.*	
Connecticut	4	105	3,365	1:6.8
Pennsylvania	1	114	4,075	1:7.7
Indiana	1	106	2,780	1:5.4
Illinois [1]	3	104	3,305	1:6.8
Average of all	9	104	3,615	1:6.8
Standard for man without muscular work		100	2,700	1:5.6
Standard for man with light muscular work		112	3,000	1:5.5

[1] Food purchased.

It will be observed that the protein is fairly in accord with the standard in all of the instances except in the case of the Pennsylvania dietary. The fuel value of food eaten is much larger than the standard except in the case of the Indiana dietary. This dietary in fuel value, nutritive ratio, and protein is very nearly that suggested in the standard for a man without muscular work. The nutritive ratio is larger than the standard in all of the dietaries except that of the Indiana family, and is particularly so in that of the Pennsylvania family.

It is very interesting to observe that so far as the average figures are concerned the dietaries of these professional men accord very nearly with the figures found for mechanics. As the following table indicates, the chief difference is found in the slightly smaller fuel value and nutritive ratio of the diet of the professional men:

Comparison of food eaten in dietaries of families of mechanics and of professional men.

	Number of families.	Per man per day.		Nutritive ratio.
		Protein.	Fuel value.	
		Grams.	*Calories.*	
Mechanics	9	105	3,570	1:7.3
Professional men	9	104	3,315	1:6.8

If the average eating habits of the families thus stated are taken as representing the average of families of their classes, it is evident that the so-called standards above referred to and the actual practice of well-to-do people in this country are not in accord. It would, however, be going too far to assume that the results of these few studies accurately represent the general practice. In order to find what the latter is, a large amount of investigation is necessary. At the same time the dietary studies of well-to-do people thus far made in the United States show, as a whole, a relatively large consumption of the fuel ingredients of food, fat, starch, and sugar, and wide nutritive ratio.

This subject has been discussed in another place.[1] It will suffice here to say that, in the opinion of the writers, the difference between the standards ordinarily adopted by physiologists and chemists and the averages of the dietary studies made in the United States, in respect to the relatively large amounts of fuel ingredients and the wider nutritive ratios of the latter, are to be explained by a simple but important fact, namely, that foods containing fat, starch, and sugar are so abundant and so agreeable to the palate.

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[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, pp. 206–214.